NO. 94-018

CESSNA A185E

ZK-JEM

MASON BAY, STEWART ISLAND

25 AUGUST 1994

ABSTRACT

On 25 August 1994 as the aircraft slowed following a beach landing, the left undercarriage leg collapsed. Initial looseness of the leg attachment bolt or loss of torque in service was likely to have reduced the integrity of the undercarriage assembly.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

AIRCRAFT ACCIDENT REPORT NO. 94-018

Aircraft Type, Serial Number and Registration:	Cessna A185E, 185-01780 ZK-JEM
Number and Type of Engines:	Teledyne Continental IO-520-D
Year of Manufacture:	1970
Date and Time:	25 August 1994, 0830 hours*
Location:	Mason Bay, Stewart Island Latitude: 46° 56'S Longitude: 167° 43'E
Type of Flight:	Air Transport—Charter
Persons on Board:	Crew: 1 Passengers: 3
Injuries:	Crew: Nil Passengers: Nil
Nature of Damage:	Substantial
Pilot in Command's Licence:	Commercial Pilot Licence (Aeroplane)
Pilot in Command's Age:	29
Pilot in Command's Total	450 hours 48 hours on type
Flying Experience:	
Information Sources:	Pilot Report Engineering Investigation
Investigator in Charge:	Mr D G Graham

* All times in this report are NZST (UTC + 12 hours)

1. NARRATIVE

1.1 On 25 August 1994 ZK-JEM, a Cessna 185, was used to transport three hunters and their gear from Invercargill to Stewart Island. They were landed at Mason Bay, a large open bay some 13 km long, on the west coast of the Island. Appropriate areas of the beach were routinely used for aircraft operations, the flat sand exposed at low tide normally providing a suitably firm smooth surface for landing and take-off. Operations were restricted to within a period of approximately 40 minutes before or after low tide.

1.2 After checking from the air for debris and other obstructions the pilot set up a normal approach for a landing along the beach, which curved toward the south west in the chosen area. The wind was west-south-westerly at about 15 knots to 20 knots resulting in a slight cross wind from the right during the landing. Touchdown and the initial landing roll were uneventful, but as the aircraft slowed to approximately 5 knots, the left undercarriage leg suddenly collapsed. The aircraft subsided onto its left wingtip, deforming the outboard section of the left wing, and the cargo pod, fitted beneath the fuselage, sustained minor damage as it took the aircraft's weight. Engine rpm had already decreased to a low idle and no damage occurred to the propeller.

1.3 The mishap occurred about 15 minutes after low tide. The pilot ran some 3.5 km to an unoccupied homestead near the southern end of the beach and returned with a tractor and trailer. The left wing of the aircraft was raised and the immobilised aircraft was dragged some 20 m up the beach to a position clear of the incoming tide. The aircraft was subsequently lifted from the area by helicopter and transported beneath it to Invercargill Aerodrome.

1.4 Immediately after the occurrence the pilot inspected the area of beach on which he had landed. He could see no obvious soft patches or obstructions which might have imposed adverse loads on the undercarriage and precipitated the collapse of the left leg. He noted that the inboard end of the left leg was completely detached from the bracket to which it was normally secured. The retaining bolt was still in place in the leg but the threads were stripped and the nut, which also exhibited stripped threads, was lying loose on the lower skin of the internal undercarriage box on the aircraft's left side. There was a washer .060 inches thick under the head of the bolt, but no other washers or shims were found which might have been positioned between the nut and the inboard bracket to which the leg was attached.

1.5 The left undercarriage leg had been forced rearwards and folded inwards during the occurrence. Damage to the forward bulkhead and bending of the retaining bolt was consistent with such a sequence. The upper section of the outer bracket, through which the undercarriage leg passed and in which it was normally held firmly by a pair of wedges, had failed as a result of overload. Some distortion of the bolt hole in the inboard bracket had occurred, probably during the undercarriage collapse. However, step marks on the bolt and a wear pattern on the upper face of the bracket indicating that fretting had taken place between the leg and the bracket suggested that the retaining bolt had been loose for some time prior to the mishap.

1.6 The undercarriage leg retaining bolt specified by the aircraft manufacturer was AN7-20A (This designated a standard aircraft bolt of given diameter and length). Measurement of the damaged bolt recovered from the aircraft showed that, although it was of the correct diameter, its length corresponded to that of an AN7-23A. This meant that the "grip" of the bolt (the length of the unthreaded portion of the shank) was some 0.375 inches in excess of that specified by the manufacturer. Measurement showed that the thickness of the undercarriage leg and the inboard bracket conformed to standard. There was therefore no special circumstance requiring the use of a longer than normal bolt.

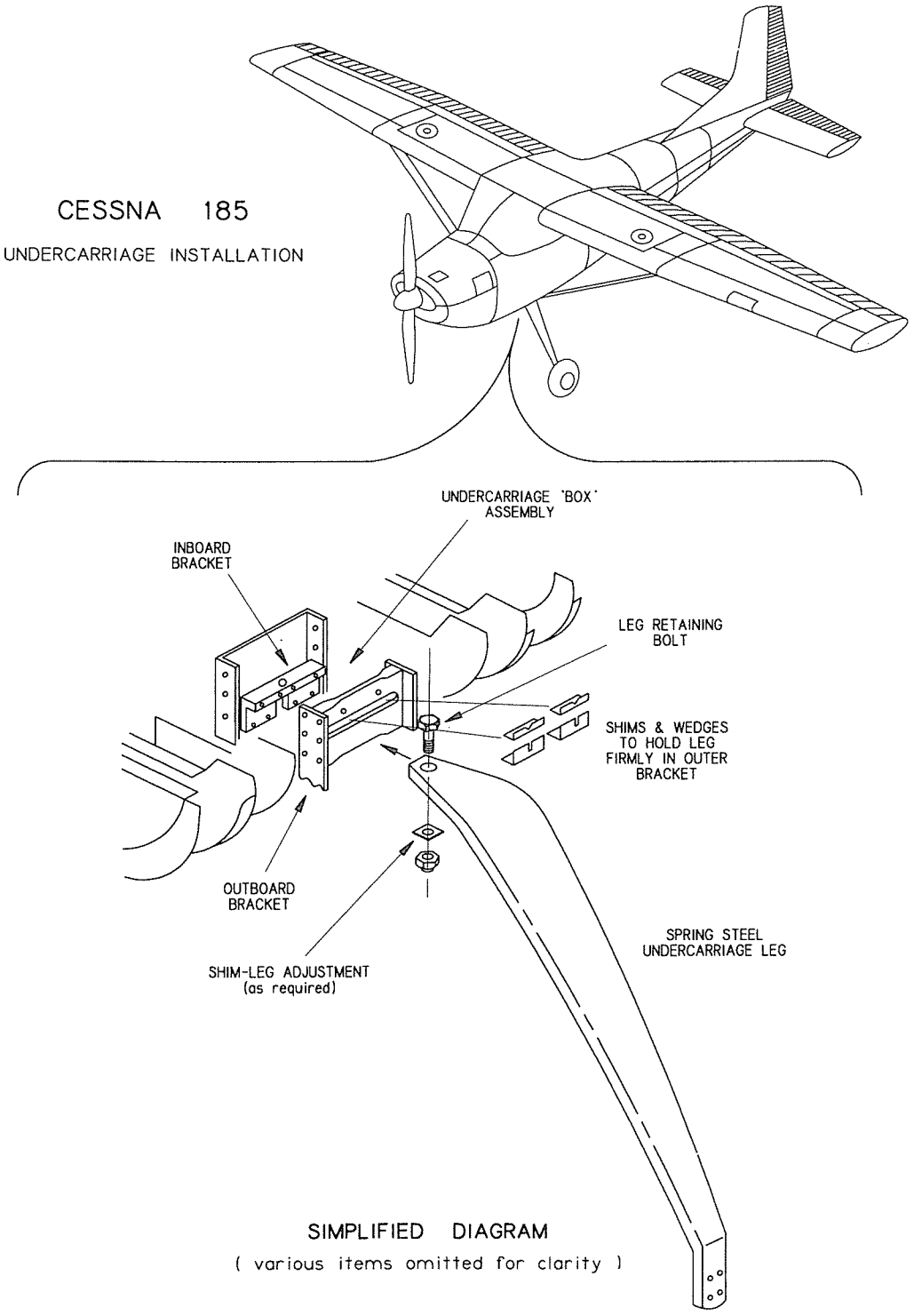
CESSNA 185
UNDERCARRIAGE INSTALLATION
UNDERCARRIAGE 'BOX' ASSEMBLY
INBOARD BRACKET
LEG RETAINING BOLT
SHIMS & WEDGES TO HOLD LEG FIRMLY IN OUTER BRACKET
OUTBOARD BRACKET
SHIM-LEG ADJUSTMENT (as required)
SPRING STEEL UNDERCARRIAGE LEG
SIMPLIFIED DIAGRAM
(various items omitted for clarity)

Figure 1

1.7 The use of a retaining bolt with excess "grip" to secure the undercarriage leg to the inboard bracket held potential for incorrect assembly. If insufficient packing washers were initially employed, or if one of a series of washers was inadvertently omitted at some later stage such as if the leg was removed and re-installed, there was a risk that the nut could become threadbound when tightened. This could result not only in undetected damage to the threads but a consequent impression could be gained that an appropriate torque had been applied without a guarantee that the bolt was, in fact, in tension, and the leg and bracket properly clamped together. In addition, the use of excessive 'packing' increased the possibility of loss of torque due to 'bedding-in', or 'crushing', of the packing as a result of service loads. The fluctuating loads to which the undercarriage legs were subjected in day to day operation were likely to have induced relative movement between the leg and the bracket once a loss of torque occurred. The extent of wear on the bracket of ZK-JEM indicated this had occurred.

1.8 The spring steel legs of the Cessna 185 were designed to absorb the forces associated with operation of the aircraft type from a variety of differing surfaces. With the aircraft's weight on the main wheels the inboard end of the leg pressed against the upper surface of the inboard bracket and the leg retaining bolt was largely subject to loading in shear. However, in flight, and particularly during take-offs and landings on soft or undulating ground, as the undercarriage legs flexed up and down, the retaining bolt was likely to sustain tensile loads of varying extent. Any untoward event such as a minor groundloop, significant bounce , or heavy landing was also likely to induce unusual loading on the bolt and increase the possibility of thread stripping if looseness in the assembly already existed.

1.9 ZK-JEM had been imported to New Zealand from Australia in July 1993 with a total airframe time of 8198 hours. In November 1993 the right undercarriage leg had been removed, inspected, and re-installed to rectify a slight "creak" which had become evident. Subsequent routine maintenance, which had included raising the aircraft on jacks and check tightening the undercarriage wedges on both sides, had disclosed no obvious defect or anomaly in the left undercarriage assembly. The aircraft had flown approximately 150 hours on operations in New Zealand at the time that the mishap occurred. It had flown 13 hours since the most recent maintenance inspection. Although there had been no prior indication to alert the pilot to a potential problem involving the left undercarriage, effective securing action of the wedges was likely to have masked for some time initial looseness or gradual loss of torque of the attachment bolt.

1.10 The Australian logbooks indicated that the left and right undercarriage fittings were "repaired and rectified" in Australia in December 1991, at an airframe time of 8073 hours. Work records showed that the reinforcing angle secured to the left outboard bracket and lower fuselage skin had been replaced at this time. This would have necessitated removal and refitting of the left undercarriage leg. There was no record to suggest that the left undercarriage bolt had been disturbed since that time.

1.11 The circumstances of the mishap and the engineering evidence suggested that, unbeknown to the pilot, the left undercarriage leg attachment bolt had loosened in service over an undetermined period of time. The reduced integrity of the attachment rendered the leg vulnerable to eventual collapse. Retardation loads experienced during the beach landing were probably sufficient to result in final failure of the left attachment and consequent unexpected collapse of the undercarriage at the conclusion of the landing roll.

2. FINDINGS

2.1 The pilot in command was appropriately licensed to conduct the flight.

2.2 The aircraft had a valid Certificate of Airworthiness and Maintenance Release.

2.3 The aircraft's operating weight and centre of gravity were within the specified limits.

2.4 The left undercarriage leg collapsed when the aircraft had reached a slow speed in the course of a beach landing.

2.5 The threads of the bolt and nut which attached the undercarriage leg to the airframe bracket were found to be stripped.

2.6 The attachment bolt, used to secure the undercarriage leg, was of greater length than that specified by the aircraft manufacturer.

2.7 A wear pattern indicated that movement had occurred between the undercarriage leg and the airframe bracket over an unknown period of time.

2.8 An initial looseness of the assembly, or a gradual loss of torque, contributed to undetected "working" of the undercarriage leg in service.

2.9 Loss of attachment integrity rendered the left undercarriage vulnerable to eventual collapse.

2.10 The left undercarriage leg had last been removed from the aircraft and replaced in Australia, in 1991.

7 December 1994

M F Dunphy
Chief Commissioner

ABBREVIATIONS COMMONLY USED IN TAIC REPORTS

AD	Airworthiness Directive
ADF	Automatic direction-finding equipment
agl	Above ground level
AI	Attitude indicator
AIC	Aeronautical Information Circular
AIP	Aeronatical Information Publication
amsl	Above mean sea level
ASI	Airspeed indicator
ATA	Actual time of arrival
ATC	Air Traffic Control
ATD	Actual time of departure
ATPL (A *or* H)	Airline Transport Pilot Licence (Aeroplane or Helicopter)
AUW	All-up weight
C	Celsius (normally preceded by °)
CAA	Civil Aviation Authority
CASO	Civil Aviation Safety Order
CFI	Chief Flying Instructor
CPL (A *or* H)	Commercial Pilot Licence (Aeroplane or Helicopter)
DME	Distance measuring equipment
E	East
ELT	Emergency location transmitter
ERC	En route chart
ETA	Estimated time of arrival
ETD	Estimated time of departure
F	Fahrenheit (normally preceded by °)
FAA	Federal Aviation Administration (United States)
FL	Flight level
g	Acceleration due to gravity
GPS	Global Positioning System
HF	High frequency
hPa	Hectopascals
IAS	Indicated airspeed
IGE	In ground effect
IFR	Instrument Flight Rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ins Hg	Inches of mercury
kHz	Kilohertz
KIAS	Knots indicated airspeed
kt	Knot(s)
LF	Low frequency
LLZ	Localiser
M	Mach number (e.g. M1.2)

M	Magnetic (normally preceded by °)
MAANZ	Microlight Aircraft Association of New Zealand
MAP	Manifold absolute pressure (measured in inches of mercury)
MAUW	Maximum all-up weight
METAR	Aviation routine weather report (in aeronautical meteorological code)
MF	Medium frequency
MHz	Megahertz
mph	Miles per hour
N	North
NDB	Non-directional radio beacon
NOTAM	Notice to Airmen
nm	Nautical mile
NZAACA	New Zealand Amateur Aircraft Constructors Association
NZGA	New Zealand Gliding Association
NZHGPA	New Zealand Hang Gliding and Paragliding Association
NZMS	New Zealand Mapping Service map series number
NZDT	New Zealand daylight time (UTC + 13 hours)
NZST	New Zealand standard time (UTC + 12 hours)
NTSB	National Transportation Safety Board (United States)
OGE	Out of ground effect
PAR	Precision approach radar
PIC	Pilot in command
PPL (A *or* H)	Private Pilot Licence (Aeroplane or Helicopter)
psi	Pounds per square inch
QFE	An altimeter subscale setting to obtain height above aerodrome
QNH	An altimeter subscale setting to obtain elevation above mean sea level
RNZAC	Royal New Zealand Aero Club
RNZAF	Royal New Zealand Air Force
rpm	revolutions per minute
RTF	Radio telephone or radio telephony
S	South
SAR	Search and Rescue
SSR	Secondary surveillance radar
T	True (normally preceded by °)
TACAN	Tactical Air Navigation aid
TAF	Terminal aerodrome forecast
TAS	True airspeed
UHF	Ultra high frequency
UTC	Coordinated Universal Time
VASIS	Visual approach slope indicator system
VFG	Visual Flight Guide
VFR	Visual flight rules
VHF	Very high frequency
VMC	Visual meteorological conditions

VOR	VHF omnidirectional radio range
VORTAC	VOR and TACAN combined
VTC	Visual terminal chart
W	West